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(54) **IMAGE SENSOR**

(57) Abstract:
PROBLEM TO BE SOLVED: To provide an image sensor which can improve light sensitivity by suppressing or preventing blooming effect.
SOLUTION: The image sensor has multiple unit pixels. Each unit pixel has a photo-sensing means 210 sensing incident light and generating photo-electric chargea transmission means 220 transmitting the photo-electric charge to a sensing nodea first resetting means 230A resetting the sensing node by generating a complete depletion area in the photo-sensing means and supplying power voltage to the sensing node and a second resetting means 230B transmitting overcharge generating in the photo-sensing means to a power line when the sensing node is reset.

CLAIMS

[Claim(s)]
[Claim 1]In an image sensor which it hasmany unit pixels each unit pixelBy making a perfect depletion region generate and supplying power supply voltage at said sense nodes in a light sensing means which detects incident light and generates a photoelectrical loada transmission means which transmits said photoelectrical load to sense nodesand said light sensing meansAn image sensor provided with the 1st resetting means that makes said sense nodes resetand the 2nd resetting means that transmits excess charges generated by said light sensing means when said sense nodes were reset to a source line.
[Claim 2]The image sensor according to claim 1 having amplified a voltage level of said sense nodes and having further an amplifying means which generates the amplified signaland a switching means which carries out switching operation and outputs said amplified signal to an outgoing end.
[Claim 3]The image sensor according to claim 1wherein said transmission means is connected between said light sensing means and said sense nodes.
[Claim 4]The image sensor according to claim 3wherein said 1st resetting means is connected between said sense nodes and said source line.
[Claim 5]The image sensor according to claim 4wherein said 2nd resetting means is connected between said light sensing means and said source line.
[Claim 6]The image sensor according to claim 5wherein said light sensing means is a photo-diode.
[Claim 7]The image sensor according to claim 6wherein said means of communication is a nMOS transistor.
[Claim 8]The image sensor according to claim 7wherein said 1st and 2nd resetting means are nMOS transistors.
[Claim 9]The image sensor according to claim 8wherein threshold voltage of said 2nd resetting means is lower than threshold voltage of said 1st resetting means.
[Claim 10]The 1st doping region of the 2nd conduction type with which said photo-diode was formed on a semiconductor substrate of the 1st conduction typeand a semiconductor substrate of said 1st conduction typeThe image sensor according to claim 9 provided with the 2nd doping region of the 1st conduction type formed on this 1st doping region.
[Claim 11]The image sensor according to claim 10wherein channel regions of said 2nd doping region are directly connected with the 1st doping region.
[Claim 12]The image sensor according to claim 11 with which said 2nd doping region is characterized by being in contact

with said semiconductor substrate.
[Claim 13]The image sensor according to claim 12wherein said 1st conduction type is a p type and said 2nd conduction type is a n type.
[Claim 14]The image sensor according to claim 10wherein said semiconductor substrate is further provided with an epitaxial layer which is formed on said semiconductor substrate and has impurity concentration lower than impurity concentration of a semiconductor substrate.

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[The technical field to which invention belongs] Especially this invention relates to the image sensor which has a unit pixel of a large number which can prevent the blooming effect about an image sensor.
[0002]
[Description of the Prior Art]As everyone knowsan image sensor is equipment which detects the light reflected from an object and generates image data. The image sensor especially manufactured using CMOS (complementary metal oxide semiconductor) technology is called CMOS image sensor.
[0003]Generallythe CMOS image sensor contains many unit pixels.
Each unit pixel consists of one optical sensing element and many transistors.
An optical sensing element like a photo-diode detects the incident light reflected from an objectand accumulates a photoelectrical loadand a transistor controls transmission of the accumulated photoelectrical load.
[0004]Drawing 1 A is a circuit diagram showing the conventional unit pixel contained in the CMOS image sensor. Herethe mark 160 is a load transistor which carries out the role which stabilizes the output signal of a unit pixel. Drawing 1 B is Drawings in which the layout over the conventional unit pixel shown in drawing 1 A is shown.
[0005]As illustratedthe conventional unit pixel consists of the one photo-diode 110 and four nMOS transistors. Four nMOS transistors are provided with the function of the transmission transistors 120the reset transistor 130the amplification transistor 140and the switching transistor 150respectively.
[0006]The photo-diode 110 detects incident light and generates a photoelectrical load. The transmission

transistors 120 are connected with the sense nodes Ns. The transmission control signal TX is answered and a photoelectrical load is transmitted to the sense nodes Ns.

[0007]The reset transistor 130 is connected with the sense nodes Ns.
Answer a reset control signala perfect depletion region is made to form in the photo-diode 110and reset voltage is supplied to sense nodes.
The amplification transistor 140 generates the signal (DX) amplified by amplifying the voltage level of the sense nodes Ns. The switching transistor 150 is connected with the amplification transistor 140 and the outgoing end Nout. The signal amplified via the outgoing end Nout is outputted as image data by answering switching control signal SX and carrying out switching operation.

[0008]In order to raise an electric charge transmission efficiency and to decrease a voltage loss or voltage drop of image data in four nMOS transistorsThe transmission transistors 120 and the reset transistor 130 are embodied by the negative nMOS transistor which has a depletion mode (depletion mode) nMOS transistor or low threshold voltage.
[0009]The process in which the sense nodes Ns are made to reset by this unit pixelSince it is performed by the transmission transistors 120 and the reset transistor 130the course of excess charges should be formed in the source line VDD from the transmission transistors 120 and the reset transistor 130 in the saturation region. Thereforethe control to the voltage barrier of the transmission transistors 120 and the reset transistor 130 is very important. If at least one of the transmission transistors 120 and the reset transistors 130 is not controlled correctlyexcess charges become flowing into the unit pixel which adjoinedand will induce malfunction. This phenomenon is called blooming effect (blooming effect).
[0010]By the blooming effectit becomes difficult to gain exact image dataand there is a problem of reducing the photosensitivity of a CMOS image sensor.
[0011]
[Problem to be solved by the invention]The purpose is in providing the image sensor which can increase photosensitivity by being thought out in order that this invention may solve the problem mentioned aboveand inhibiting or preventing the blooming effect.
[0012]
[Means for solving problem]This invention is characterized

by an image sensor comprising the followingin order to attain said purpose.
The light sensing means which it has many unit pixelsand each unit pixel detects incident lightand generates a photoelectrical load.
The transmission means which transmits said photoelectrical load to sense nodes.
The 1st resetting means that makes these sense nodes reset by making a perfect depletion region generate and supplying power supply voltage in said light sensing means at said sense nodes.
The 2nd resetting means that transmits the excess charges generated by said light sensing means when said sense nodes were reset to a source line.

[0013]
[Mode for carrying out the invention]In order to explain in detail to such an extent that those who have hereafter the usual knowledge in the technical field which belongs this invention can carry out this invention easilythe desirable embodiment of this invention is described with reference to the attached Drawings.
[0014]Drawing 2 A is a circuit diagram showing the unit pixel contained in the CMOS image sensor concerning this invention. The mark 260 shows the load transistor used in order to stabilize the output signal of a unit pixel. Drawing 2 B is Drawings in which the layout of the unit pixel illustrated to drawing 2 A is shown.
[0015]If drawing 2 A is referred tothe unit pixel concerning this invention will consist of the one photo-diode 210 and five nMOS transistors as a control means as an optical sensing element. Five nMOS transistors are the transmission transistors 220the 1st reset transistor 230Athe 2nd reset transistor 230Bthe amplification transistor 240and the switching transistor 250.
[0016]The photo-diode 210 detects incident light and generates a photoelectrical load. The transmission transistors 220 are connected between the photo-diode 210 and the sense nodes Nsanswer the transmission control signal TXand transmit a photoelectrical load to the sense nodes Ns.
[0017]The 1st reset transistor 230A carries out a reset action by being connected between the sense nodes Ns and the source line VDDanswering reset control signal RXmaking a perfect depletion region form in the photo-diode 210and supplying reset voltage to the sense nodes Ns.
[0018]The 2nd reset transistor 230B is connected between

the photo-diode 210 and the source line VDDand transmits the excess charges generated with the photo-diode 210 to the source line VDD. In this caseexcess charges are made to be transmitted to the source line VDD by forming lower than the threshold voltage of the 1st reset transistor 230A the threshold voltage of the 2nd reset transistor 230B easily.
[0019]The amplification transistor 240 generates the signal (DX) amplified by amplifying the voltage level of the sense nodes Ns. The switching transistor 250 is connected between the amplification transistor 240 and the outgoing end Noutand outputs the signal amplified via the outgoing end Nout with image data by answering switching control signal SX and carrying out switching operation.
[0020]As illustrated to drawing 2 Bit connects with the conductive layer with same gate G1 of the 1st reset transistor 230A and gate G2 of the 2nd reset transistor 230B.
[0021]Drawing 3 A and drawing 3 B are the sectional views cut by the A'-A line shown in drawing 2 Band the A"-A linerespectively. If drawing 3 A and drawing 3 B are referred tothe photo-diode 210 concerning this invention is provided by forming the n type doping region 302 and the p type doping region 303 in order on the semiconductor substrate 301. The channel regions of the 2nd reset transistor 230B are directly connected with the n type doping region 302 of the photo-diode 210 like the transmission transistors 220.
[0022]As for the semiconductor substrate 301it is preferred to be provided by forming a p type epitaxial layer on a p type substrate. In this caseimpurity concentration of a p type epitaxial layer is made lower than the impurity concentration of a p type substrate. A perfect depletion region can be formed in a photo-diode also with the power supply voltage of 5Vor 3.3 thru/or 2.5V by forming so that the p type doping region 303 may contact the semiconductor substrate 301 directly.
[0023]Drawing 4 is Drawings in which potential of a unit pixel after a reset action is shown. Since threshold voltage of the 2nd reset transistor 230B is lower than threshold voltage of the 1st reset transistor 230Athe excess charges 401 are easily transmitted to the source line VDDand can prevent the blooming effectand photosensitivity of a CMOS image sensor improvesso that Drawings may show.
[0024]technical idea of this invention -- the above -- although a desirable working example describedit is clear in a person skilled in the art for various

changeadditionsand substitution to be possible within the limits of this invention limited by a claim.
[0025]
[Effect of the Invention]Movement to the contiguity unit pixel of the excess charges by which one reset transistor is added to the conventional unit pixel structureand the photo-diode was easily formed into perfect depletionand the image sensor of this invention was generated with the photo-diode is controlled. Thereforeimprovement in photosensitivity can be aimed at.

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1 A] It is a circuit diagram showing the conventional unit pixel contained in the CMOS image sensor.
[Drawing 1 B] They are Drawings in which the layout of the unit pixel shown in drawing 1 A is shown.
[Drawing 2 A] It is a circuit diagram showing the unit pixel contained in the CMOS image sensor concerning this invention.
[Drawing 2 B] They are Drawings in which the layout of the unit pixel shown in drawing 2 A is shown.
[Drawing 3 A] It is an A'-A line sectional view in drawing 2 B.
[Drawing 3 B] It is an A"-A line sectional view in drawing 2 B.
[Drawing 4]They are the Drawings in a reset action in which the potential of a unit pixel is shown.
[Explanations of letters or numerals]
210 Photo-diode
220 Transmission transistors
230A The 1st reset transistor
230B The 2nd reset transistor
240 Amplification transistor
250 Switching transistor
302 N type doping region
303 P type doping region